ZERO BOUND INTEREST RATE POLICY AND THE DYNAMICS OF ECONOMIC GROWTH

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Abstract: *The article aims to identify dependencies between the central bank's interest rate and GDP dynamics in selected economies and to highlight the risks of a zero bound interest rate policy for an economy. The hypothesis that the main interest rates and GDP dynamics in the euro area, USA and Poland are statistically significantly related to each other was confirmed. The purpose of the article was accomplished using the following methods: a review of the scientific literature, the presentation of pertinent statistical data and statistical analysis. Its findings imply that although a low cost of money can stimulate a country's economy, prolonged periods of zero bound interest rates can be a threat to economic expansion.*

Keywords: *monetary policy, zero bound interest rates, deflation, economic growth*

1. Introduction

The years of the Great Depression in the 1930s were a period of severe deflation. In many countries where deflation has occurred despite the nominal interest rate having been reduced to almost zero economic activity slackened [1]. At the same time, though, in many countries deflation has not been accompanied by a lower rate of GDP growth. For instance, in 2002, deflation did not prevent the Chinese rate of GDP growth from reaching 8% [2]. This said, it must be noticed that the literature provides more evidence that low interest rates have a negative effect on national economies. It is also noteworthy that interest rates have a major influence on the rate of economic growth and that the influence is negative when they are either too high or too low.

2. Deflation, zero bound interest rates and an economy

Economies in deflation have to pay many costs, one of which arises from the "explosion" of bad debts that takes place when some debtors have to spend a higher percentage of their income to service debt liabilities when the amount of loan instalments does not change while their income (in monetary terms) decreases as prices fall [3]. A major threat related to a zero bound interest rate is the risk of collapse of the financial sector, because easily available loans are frequently spent on assets, which consequently drives their prices upward and thereby the value of collaterals [4], [5]. A prolonged period of low interest rates can lead to the emergence of a speculative bubble in the assets market, the bursting of which can destabilize the financial sector [6]. Economists hold different views on how a central bank should respond to the emergence or bursting of such bubbles. Some argue that because central banks cannot recognize that a market bubble is being formed, they should focus on offsetting their impacts. A relevant example is the situation from before the most recent financial crisis, when the major central banks believed that pursuing a zero bound interest rate policy was right even at the risk of deflation [7], [8], [9]. From 2002 to 2006, the US interest rate was some 2.5% lower than that recommended by the Taylor rule [6] (in Taylor's opinion, the US monetary policy in the pre-crisis years was either not restrictive enough or too loose). This departure from the Taylor rule lasted longer than in the 1970s. The Fed explained this extraordinary reduction of interest rates as an intended abandonment of conventional monetary policy rules in order to enable a discretionary intervention against deflation (such as that observed in Japan in the 1990s) [10]. The formulas below represent the original Taylor rule and its version with parameters calibrated for the USA. The first of the formulas is the following:

$$i_t = \pi_t + \emptyset_\pi(\pi_t - \pi^*) + \emptyset_x x_t + r^*$$

where, i_t = the nominal federal funds rate in period t, π_t = the annual rate of inflation in period t (%), π^* = inflation target in period t (%), x_t = GDP gap (demand) in period t (GDP deviation from its potential level, %), r^* = the real interest rate corresponding to full employment (natural interest rate), $\emptyset_x$, $\emptyset_\pi$ = structural parameters.
The calibrated formula reads as follows [11]:

$$i_t = \pi_t + 0.5(\pi_t - 2) + 0{,}5x_t + 2$$

Baranowski noted that the Taylor rule offered a guideline for monetary policy. As well as facilitating the forecasting of interest rates, the rate is also an important element of theoretical and empirical models of the national economy [12].
Another threat arising from a zero bound interest rate policy is that low interest rates can make risky projects appealing to banks. For instance, interest rate reductions in the US increased the risk of loans, because banks started to lend at lower prices and to borrowers of questionable creditworthiness [13]. Researchers studying Spanish loan records spanning a period of 23 years made a similar observation. They noted that interest rate reductions were followed by an increasing amount of loans granted to borrowers that either had a bad borrowing history or did not have such history at all. Their conclusion was that the

credit risk increases with an extending period of low interest rates [14]. Having analysed the impacts of interest rates staying low for a long time after the financial crisis, Rzonca concluded that the maintenance of zero bound interest rates was harmful to economic growth [6]. Nevertheless, some economists believe that the quantitative easing policy should be continued, because the world economy may plunge into another crisis unless banks continue to support economic growth with low interest rates.

3. Analysis of dependencies between central banks' interest rates and the rate of economic growth in USA, the euro area and Poland

This section presents statistical data on the main interest rates, inflation and GDP dynamics in the USA, the euro zone and Poland, as well as the results of regression analysis of the rates' influence on GDP dynamics in these economies.

Table 1 shows the levels of the main interest rates set by the central banks in the euro area (the main refinancing operation rate), the USA (the federal funds rate) and Poland (the reference rate) between 1999 and 2016. Because the rates were frequently changed over a year, the table presents their annual arithmetic means, excluding the US interest rates in the period 2009-2016 that are shown as bands.

Table 1 Main interest rates of central banks in euro area, USA and in Poland

Year	Main refinancing operation rate ECB	Federal funds rate USA	Reference rate NBP
1999	2,90	5,25	14,50
2000	4,04	6,08	18,25
2001	3,94	3,73	14,43
2002	2,75	1,25	8,28
2003	2,25	1,00	5,88
2004	2,00	1,75	6,08
2005	2,25	3,38	5,15
2006	3,00	4,88	4,13
2007	3,88	4,50	4,63
2008	3,44	1,93	5,54
2009	1,44	0-0,25	3,88
2010	1,00	0-0,25	3,50
2011	1,25	0-0,25	4,13
2012	0,75	0-0,25	4,50
2013	0,38	0-0,25	3,21
2014	0,10	0-0,25	2,00
2015	0,05	0,25-0,50	1,50
2016	0,00	0,25-0,50	1,5

The long-term interest rates were low over the analysed years, especially in the euro area and the USA. The Polish interest rates are now at their historic low level, but at the end of the 20th c. and in the early 21st c., they were much higher than in the euro area and the USA.

Table 2 shows the 1999-2015 economic growth rates for the euro area, USA and Poland. The growth dynamics of GDP was the lowest in the euro area, somewhat higher in the USA, and the highest in Poland. It needs to be noted, however, that Poland is counted among the "catching-up" countries (emerging markets) where GDP growth is typically higher than in developed economies.

Table 2 GDP growth in Euro Area, USA and in Poland

Year	GDP growth rate in Eurozone	GDP growth rate in USA	GDP growth rate in Poland
1999	3	4,69	4,6
2000	3,8	4,09	4,3
2001	2,1	0,98	1,2
2002	0,9	1,79	1,4
2003	0,6	2,81	3,9
2004	2,3	3,79	5,3
2005	1,6	3,35	3,6
2006	3,2	2,67	6,2
2007	2,9	1,78	6,8
2008	0,4	-0,29	5,1
2009	-4,4	-2,78	1,6
2010	2,1	2,53	3,9
2011	1,5	1,60	4,5
2012	-0,9	2,22	2
2013	-0,3	1,49	1,6
2014	1,1	2,43	3,3
2015	2	2,43	3,6

Table 3 contains annual inflation rates for the euro area, USA and Poland in the same period. The rates were low in both the euro area and the USA. The Polish inflation rate was high in the years 1999-2001 but in 2002, it abruptly dropped below 2% to rise above 4% in 2004. An inflation rate of 2.4% or less was not noted in Poland until 2012. The years 2014-2015 were a period of deflation.

Table 3 Inflation in Euro Area, USA and in Poland

Year	Inflation in Eurozone	Inflation in USA	Inflation in Poland
1999	2,2	1,1	7,30
2000	3,4	2,1	8,50
2001	2,8	2,3	3,60
2002	1,6	2,2	0,80
2003	2,3	2,1	1,70
2004	2,7	2,1	4,40
2005	3,4	2,2	0,70
2006	3,2	2,2	1,40
2007	2,9	2,1	4,00
2008	3,8	3,3	3,30
2009	-0,4	0,3	3,50
2010	1,6	1,6	3,10
2011	3,2	2,7	4,60
2012	2,1	2,5	2,40
2013	1,5	1,4	0,70
2014	1,6	0,4	-1,00
2015	0,1	0,0	-0,50

Below, a regression analysis of the selected variables is presented. It aimed to find out which dependencies between central banks' main interest rates and GDP dynamics in the three selected areas were statistically significant in the years 1999-2015 and to test a null hypothesis H_0 (the variables' parameters are not significant) and an alternative hypothesis H_1 (the parameters are significant). The variables were checked for

stationarity with the use of the ADF test (the Dickey–Fuller test). The necessary data were obtained from the Eurostat, World Bank and Polish Statistical Office websites [15], [16], [17].

Table 4 contains the regression results for the USA. The independent variables were the nominal federal funds rate [FEDF_USA] and the nominal federal funds rate lagged by one year [FEDF_USA_1]; the dependent variable was GDP dynamics in the USA [GDP_USA].

Table 4 The dependent variable (Y): GDP_USA; independent variables (X) – FEDF_USA and FEDF_USA_1

Variable name	*Coefficient*	*Standard error*	*t-Student*	*p-value*
Const	1,88835	0,458773	4,116	0,0012***
FEDF_USA	0,968802	0,263448	3,677	0,0028***
FEDF_USA_1	−0,819561	0,247387	−3,313	0,0056***
Selected regression statistics and analysis of variance: 2000-2015 observations (N = 16))				
R-square 0,517774				
F(2, 13) 6,979167 p-value for F test 0,008732				

The data in the table point out that the nominal federal funds rate and the federal funds rate lagged by one year had a significant effect on GDP dynamics in the sampled years. This conclusion is based on Student's t- statistics of 3.677 and -3.313, respectively, and on the probabilities of obtaining them (0.0028 < p=0.05 and 0.0056 < p=0.05) that allow rejecting the null hypothesis H_0 in favour of the alternative hypothesis H_1. There is a 95% probability that between 1999 and 2015 both these rates and GDP dynamics in the USA were statistically significantly related to each other. The value of the coefficient in table 4 is negative (−0.819561) only for the second rate, meaning that the influence of interest rates on GDP dynamics in the USA is consistent with economic theory. Further, the coefficient for the nominal federal funds rate is positive (0.968802), indicating that the GDP growth rate in the USA increases as the Fed raises the federal funds rate.

Table 5 shows the regression results for the euro area. In this case, the independent variables were the ECB's main refinancing operation rate [REF_ECB] and the ECB's main refinancing operation rate lagged by one year [REF_ECB_1]; the dependent variable was GDP dynamics in the euro area [GDP_ECB].

Table 5 The dependent variable (Y): GDP_ECB; independent variables (X) – REF_ECB and REF_ECB_1

Variable name	*Coefficient*	*Standard error*	*t- Student*	*p-value*
Const	1,30129	0,540457	2,408	0,0316**
REF_ECB	2,20292	0,363609	6,058	4,04e-05***
REF_ECB_1	−2,07964	0,389467	−5,340	0,0001***
Selected regression statistics and analysis of variance: 2000-2015 observations (N = 16)				
R-square 0,739698				
F(2, 13) 18,47099 p-value for F test 0,000159				

An analysis of the data in table 5 leads to a conclusion that the ECB's nominal interest rate and the nominal interest rate lagged by one year rate had a statistically significant influence on GDP dynamics in the euro area. A proof of this is Student's t-statistics of 6.058 and -5.340, respectively, and the probabilities of obtaining them (4.04e-05 < p=0.05 and 0.0001 < p=0.05) that allow rejecting the null hypothesis H_0 in favour of the alternative hypothesis H_1. There is a 95% probability that in the period under consideration both these rates were statistically significantly related to GDP dynamics in the euro area. As in the previous case, the coefficient is negative (−2.07964) only for the ECB's main rate lagged by one year, implying, again, that the effect of interest rates on GDP dynamics in the euro area was consistent with economic theory. The positive value of the coefficient for the ECB's nominal interest rate (2.20292) indicates that the raising of interest rates by the ECB stimulates GDP growth.

Table 6 presents the regression results for Poland. The independent variables in the analysis were the NBP's reference rate [REF_NBP] and the NBP's reference rate lagged by one year [REF_NBP_1]; the dependent variable was the dynamics of Polish GDP [GDP_POL].

Table 6 The dependent variable (Y): GDP_POL; independent variables (X) – REF_NBP and REF_NBP_1

Variable name	*Coefficient*	*Standard error*	*t-Student*	*p-value*
Const	4,46671	0,667096	6,696	1,48e-05 ***
REF_NBP	0,386282	0,189698	2,036	0,0626 *
REF_NBP_1	−0,461657	0,177164	−2,606	0,0218 **
Selected regression statistics and analysis of variance: 2000-2015 observations (N = 16)				
R-square 0,355107				
F(2, 13) 3,579188 p-value for F test 0,057766				

The above data indicate that both independent variables significantly influenced the dynamics of the country's GDP in the analysed period. This conclusion can be drawn from Student t-statistics of 2.036 and −2.606, respectively, and from the probabilities of obtaining them (0.0626 < p=0.1 and 0.0218 < p=0.05) that allow rejecting the null hypothesis H_0 in favour of the alternative hypothesis H_1. There is a 95% probability that in the analysed years the relationship between NBP's reference rate and the reference rate lagged by one year, on the one hand, and the dynamics of Poland's GDP, on the other, was statistically significant. The negative value of the coefficient (−0.461657) for the first rate indicates that the relationship was consistent with economic theory again. The coefficient for the second rate is positive (0.386282), meaning that the Polish GDP increased following rises in the NBP's reference rate.

The results of the analysis indicate that in the sampled years the dependencies between central banks' main interest rates and GDP dynamics were statistically significant in the USA, the euro area and Poland. As monetary policy plays a significant role in economies, central banks need to be watched carefully for changes in their interest rates.

4. Conclusions

Economic policy makers take interest in deflation only when inflation rates fall substantially and the short-term interest rates are reduced. The maintenance of near-zero nominal interest rates frequently prevents the use of measures counteracting deflationary shocks that affect price levels and production. The purpose of this article has been to highlight that there are significant relationships between central banks` main interest rate in the USA, the euro area and Poland and the rate of economic growth in these regions. As regards the consequences of these relationships, both interest rates that are too low or too high can have a negative effect on an economy.

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